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EDITORS' OUTLOOK

As we view the paths of teachers, do we find Ruts or Research? One is following the line of least resistance when he teaches his course exactly the same way year after year; changing the text-book or revising the lectures means work for the teacher. And when we teach that bugbear, valence, for instance, in just the same way that we have taught it a dozen times before, we are prone to forget that it is only the first time the student has faced the subject. The good teacher needs to keep himself warm and fresh by coming in close touch with the simple things that are so difficult; he must see chemistry, not from his peak of superior knowledge, but from the valley of despair where his students are. That is trite, but important.

Now a full appreciation of the difficulties demands thoughtful study of our successes and failures in teaching. An old teacher once boasted that he never taught his course two successive years without modification. If he saw no way to improve it, he would retrogress occasionally in order to progress in a new direction the following year! Such changes break up that mental "set" or "complex" or whatever it is that leads us into teaching ruts.

Every successful teacher must have an interest in *research in chemical education*. Whether he can carry on experimental or theoretical investigations that will fill the pages of our journals is not now the question. But should we not admit that the problems of teaching chemistry are of sufficient difficulty and importance to receive the same expert treatment that we give to the conventional objects of research? Whatever may be our attitude towards educational methods in general, every teaching laboratory should be also a place for research in teaching.

Our Society is placing a new value upon the teachers of chemistry in asking that the colleges and universities provide courses for prospective teachers. In these courses the neophyte will be taught approved methods of presenting the subject, details of laboratory administration, and similar important matters. But who knows that the present best is really best? Should we not go more deeply into the question by encouraging teachers to undertake definite research problems in connection with our methods of instruction?

An important step in this direction has been taken in the work of the Committee on the Correlation of High School and College Chemistry. This was a definite problem, much concerted effort has been expended upon it, and valuable results may be expected to follow. But this is only a beginning. The problems continue to come thick and fast even after we have successfully correlated the student into college!

There is the question of the chemical curriculum. Is our usual sequence of courses the best? Do we give honor where honor is due in the matter of emphasis? Is there any sort of correlation between the courses in chemistry and those in cognate sciences? Then each course is a wide field for research: content, order, emphasis, demonstration experiments, correlation of laboratory and lectures, etc. And again there are problems in connection with the training of particular groups of students in relation to their subsequent careers, pre-medical, pre-engineering, etc. (The American Physical Society has just completed an interesting study of the instruction of pre-medical students in physics.) These questions are all of importance, not to mention such matters as laboratory administration, grading, forms of record, tests, laboratory design and materials, and so on.

It is stimulating to see here and there a laboratory which is producing new ideas along these lines. The time is now ripe for a thorough investigation of such problems. Never until the establishment of THIS JOURNAL has there been a medium for the full publication of results of this kind. Would it be amiss for the Division of Chemical Education to outline a definite program in this matter? If the meetings were conducted in part as a series of symposiums on specific problems we might hope to bring to light an abundance of good ideas that would otherwise stay at home. The most important need, however, is that the individual teacher shall be impressed with the value of research in chemical education. It is a field where everyone may take a hand.

Which shall it be, Ruts or Research?

G. H. CARTLEDGE.

QUALITATIVE ANALYSIS WITHOUT HYDROGEN SULFIDE

R. D. MULLINIX, ROCKFORD COLLEGE, ROCKFORD, ILL.

I began to investigate the possibilities of a system of analysis without hydrogen sulfide something over three years ago, before I knew that anyone had considered the subject seriously. For a time I used a simplified method in which only a few of the most familiar metals were tested for. The scheme was used during the latter part of the first year chemistry to make more interesting the study of the metals. Hydrogen sulfide is such a disagreeable substance, especially the way general chemistry students use it, in laboratories not well provided with hoods, that I decided to extend my simplified system to all the common metal ions and to compare its sensitiveness with that of the usual method in which hydrogen sulfide is the precipitating agent.

Almkvist[1] at Stockholm in 1918 had developed a method in which the precipitating agent was a mixture of sodium carbonate and sodium hydroxide, and had in addition done some work on the solubilities of certain hydroxides, namely those of manganese, nickel, cobalt and ferric iron[1]. But, although Almkvist avoided the use of hydrogen sulfide he used, later on in the course of the analysis, sodium sulfide and then added sulfuric acid. This procedure would of course require the use of a hood. He also used a distillation method to determine the arsenic and antimony. Such distillation methods are usually slow and seldom lead to a complete separation. The well known method for acid ions by A. A. Noyes is an illustration of such a system. Almkvist's distillation method makes a partial separation of the antimony, that is, antimony must be tested for in the residue and in the distillate.

When we consider the solubilities of the hydroxides and carbonates of the common metals we find that they are small and compare well with the values of the solubilities of the sulfides of these elements. We can also use high concentrations of the hydroxide and carbonate ions. The hydrated dioxide of manganese is indeed less soluble than the sulfide, in which form it is usually precipitated, and copper oxide is about as insoluble as copper sulfide. Also, we know that the hydroxides of nickel and cobalt are considered sufficiently insoluble to be used to remove these ions in the ordinary system of analysis before zinc is precipitated as sulfide.

It is not necessary to have a system of analysis that is of the greatest possible delicacy, since we are using the thing not to analyze mixtures so much as to teach the principles of chemistry. The hydroxide and carbonates are insoluble enough to be used to detect smaller "traces" that are usually put in any "unknown." If we were after the most delicate tests we could use the Marsh or some such test for arsenic and the Nessler test for ammonia.

[1] *Z. fur anorg. Chem.* **103,** 221 (1918).

We are using analytical methods to teach general relations and not to detect the smallest possible traces of ions. We might as well, therefore, have a method that can be used from start to finish on an open desk in the laboratory. It is not necessary to point out that the solubility product, principle, amphoteric hydroxide complex ions, group separations, etc., can be developed with hydroxides and carbonates as well as with sulfides. By using such a method at the end of general chemistry the student who later studies the regular qualitative courses where hydrogen sulfide is the precipitating agent will have a broader experience from which to draw for guidance in solving the many problems of analytical work.

The silver group is precipitated as usual by the addition of hydrochloric acid. The analysis of this group follows the scheme now used by all authors. From the filtrate all other ions except those of sodium, potassium, and the amphoteric hydroxides, arsenic, antimony, tin, aluminium, zinc, and chromium are precipitated by a mixture of sodium hydroxide, sodium carbonate and an oxidizer such as bromine water or hydrogen peroxide. The chromium is oxidized to chromate and the manganese to a valence of four. The precipitate, thoroughly washed, is treated with a small excess of nitric acid. Manganese dioxide is left as a residue. Excess of ammonium hydroxide added to the nitric acid filtrate will precipitate all the bismuth and iron. From the ammoniacal filtrate ammonium carbonate will precipitate barium, calcium and strontium. Analyze this precipitate in the usual manner. The magnesium in the filtrate is removed by sodium phosphate.

If the unknown contains phosphate, the alkaline earth group will precipitate with the bismuth and iron unless the phosphate is taken care of by ferric chloride as is done in other systems of analysis.

The filtrate from the magnesium contains copper, cadmium, nickel, cobalt, and mercuric mercury. Mercury is tested for and removed with stannous chloride (a very satisfactory separation) and the cadmium brought down by sodium sulfide in the presence of sodium hydroxide and potassium cyanide. The added tin will not precipitate. A portion of the filtrate from the magnesium (after the removal of mercury) is tested for copper by means of acetic acid and potassium ferrocyanide; a portion for nickel by the dimethylglyoxime test and another portion for cobalt by means of alpha nitroso beta napthol. The tin does not interfere with the tests for nickel and cobalt.

The first filtrate containing the amphoteric ions is acidified with nitric acid. A test for chromate is made on a portion of this nitric acid solution and, if chromate is not present, a few drops of sodium chromate are added to precipitate the trace of lead that may be present. The nitric acid solution is made alkaline with ammonium hydroxide, and a drop of sulfuric acid is added to precipitate the trace of lead that may be present. The

precipitate contains aluminium, antimony, tin, and the lead trace. It is dissolved in sulfuric acid and any lead sulfate filtered off. Iron filings are added to reduce the tin and to precipitate and remove the antimony. The antimony must be removed completely on account of the aluminium test. A portion of the filtrate from the antimony is tested for tin by means of mercuric chloride, and, if tin is present it is removed completely with mercuric chloride. The mercury and the added iron are removed with sodium hydroxide and bromine water, the filtrate acidified with hydrochloric acid and then made alkaline with ammonium hydroxide to detect aluminium.

The ammonium hydroxide added to precipitate the aluminium, antimony, and tin must not be used in too great an excess. An excess will carry some of the above ions into the filtrate which should contain only zinc, chromium as chromate, and arsenic as arsenate. A portion of the above filtrate is tested for zinc by the addition of sodium sulfide, and another portion for arsenic by addition of nitric acid and ammonium molybdate. Chromium has been tested for earlier in the analysis. Potassium may be tested for in this filtrate after the removal of the metal ions and the ammonium salts. A sodium flame test is made on the original unknown and also a test for the ammonium ion.

Organic matter can be destroyed as is done in any other method of analysis. If the organic matter is destroyed by concentrated sulfuric acid and nitric acid, any insoluble residue is tested for lead, calcium, strontium, chromium, bismuth, antimony, and silver. Consult the method of A. A. Noyes.

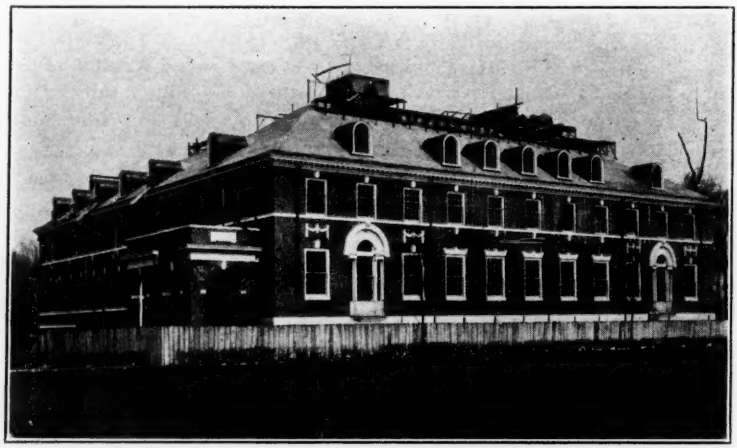
Of course ammonium salts must be absent, or if in the unknown, must be removed by boiling with a base. This is not a serious objection to the method, since ammonium salts are not common constituents of natural products, though it is true that the weird things we sometimes make up and label "unknowns" are apt to contain most everything that is not too difficult to grind.

NEW CHEMICAL LABORATORY

J. C. W. FRAZER, JOHNS HOPKINS UNIVERSITY, BALTIMORE, MD.

The following brief description of the new chemical laboratory of the Johns Hopkins University is intended merely to give a general idea of the character of the building and its equipment. It is now well on the way to completion as the photograph shows and by the time of the Spring Meeting of the Chemical Society in Washington it is hoped that the interior also will be sufficiently near completion to give a good idea of its appearance and equipment.

The building is to house both graduate and undergraduate chemistry which have been separated for so many years. It has almost 150 ft. front and extends back to a depth somewhat greater than this. It has located at the northeast corner of the quadrangle around which the university buildings are to be grouped and faces south on the quadrangle. The court which is to be enclosed by these buildings and their connecting arcades is elevated quite a little above the ground on which the buildings stand and to one viewing the building from the front it has the appearance of two stories and basement though it is really a three story building. As the buildings are all to be connected by arcades the entrances are from the arcades at each side near the front; no front entrance is provided. Owing to the



court elevation, entrance into the building is at the level of the middle floor. The position of the entrances determines the direction of circulation through the building and the corridor connecting the two entrances on this floor is duplicated on each of the other floors. The stairways go up in each wing at the ends of these corridors. The construction is brick with marble trim and the style of architecture colonial, quite similar in these respects to the old Carroll Mansion, now the Hopkins Club, only about one hundred and fifty feet east of the laboratory. The accompanying photograph gives a good idea of the exterior of the front and the side of one of the two wings.

The first two floors are devoted almost entirely to undergraduate chemistry with the exception that on the first floor there are a few constant temperature rooms in the front of the building, machine shop, battery room and locker room and showers for the undergraduates. The space in the wings (each about 44′ x 90′) on the first two floors is devoted almost entirely to

large laboratories for undergraduate instruction with offices for instructors and stockrooms for supplies. Quiz rooms are also provided on these floors.

The two undergraduate lecture rooms are located one above the other between the two wings, the larger with a seating capacity of 325 is on the ground floor, the other immediately above has a seating capacity of 150. The arrangement gives light from the north only and also admits skylight into the rear of the larger lecture room.

Storage space is provided in the basement beneath and in the large attic above. No passenger elevator is provided but a freight elevator is placed in the east wing.

The top floor is to be devoted entirely to graduate work and a general idea of the arrangements on this floor may be obtained from the following description: Advanced routine laboratory work is accommodated in four rather large laboratories one at the northern end of each wing and one in each corner of the front. The graduate lecture room with a capacity of about 80 is located about midway in the front of the building and the library just across the hallway. Lecture room and library are thus centrally located and easily accessible to those at work in any of the laboratories. Adjoining the lecture room is a stenographer's room and conference room for the use of the staff. Offices for members of the teaching staff are located convenient to one of the routine laboratories and certain of the small research laboratories to be described later. The library is an unusually attractive room with ample light all from the north and ample space for all chemical books and journals. The stockroom for this floor is located at the head of the stairway in the eastern side and adjacent to the elevator.

All research work is to be done in individual laboratories, twenty-two in number located in the two wings as shown. Each of these laboratories is 11′ x 16′. The only permanent equipment in these rooms are the hoods and sinks. The work tables in these rooms have wooden tops (in the undergraduate laboratories on the floors beneath, table tops are of alberene stone) and are made in several styles, some with only drawers beneath, some with drawers and closets, others entirely open beneath. They are made of standard length and height and so may be interchanged or removed entirely thus allowing as much flexibility as possible. In each of these rooms wooden boards about 4″ wide extend from floor to ceiling on the walls at intervals of 3′. These boards are not flush with the surface of the wall but stand out from the surface about $^1/_2$″ and to these may be attached any form of apparatus requiring permanent support. All pipes and wires are carried on permanent supports on the wall independent of the tables. The hoods have alberene bases and connections for water and gas are so arranged that all stop-cocks are outside the hood and are manipu-

lated at the front with hose attachments at the rear. The draft on each hood is produced by an individual fan and motor. All laboratory drainage and flues are of acid proof stoneware.

The whole gives the appearance of a well constructed laboratory with admirably designed exterior and interior compactly arranged for the work required; large enough for the needs of the department for many years and sufficiently flexible to meet changing conditions.

QUALITATIVE ANALYSIS IN THE FRESHMAN COURSE

JOHN E. LANSING, HOBART COLLEGE, GENEVA, N. Y.

A less formal and perhaps more descriptive title would be "How to teach the most Chemistry with the greatest satisfaction and pleasure to both student and instructor." This is a broad claim but the author's experience has justified it in his own case. He hopes that a brief statement of his experience may encourage others to try the same plan with equally satisfactory results.

When the armistice brought the World War to an end, the S. A. T. C. Unit at Hobart College promptly disbanded. Many of the same men took up regular college work at the opening of the new term a few weeks later. This meant that a group of ambitious young men who had been given the "high spots" in a course in General Chemistry wanted to go on with the subject. Their training did not amount to more than one term of college chemistry, but they would hardly have been satisfied to continue the study of General Chemistry six months longer. It was an excellent chance to try a plan which the author has been considering for some time. The men were started on a simple course in Qualitative Analysis with such satisfactory results that the plan, with such modifications as experience suggested, has been continued ever since. Perhaps the best way to bring out points which are of interest to anyone considering giving such a course is in the form of answers to a few questions.

Is there time to give a satisfactory course in Qualitative Analysis during the first year of college chemistry without neglecting the work in General Chemistry?

There undoubtedly is if five credit hours during the entire year are available. At Hobart College in the first term we have three lectures, one recitation and one laboratory period all dealing with General Chemistry. In the second term one lecture in General Chemistry, one lecture in Qualitative Analysis and two laboratory periods of three hours each in Qualitative Analysis. The third morning hour is sometimes used for tests and sometimes for drilling and helping the poorer students without requiring the attendance of those doing the best work.

If we had only four credit hours available, we could not cover the ground so satisfactorily but we should continue the plan even under these conditions. In fact we conducted this course for one year with fair success on a four hour basis.

What sort of a Qualitative Analysis can be taught in such a course?

We do not believe in sacrificing the theoretical side of the subject in order to get through the greatest possible number of "unknowns." We therefore take time in our study of the "Preliminary Reactions" of the groups to write a large number of equations and make a good many applications of mass law principles, ionic equations and solubility product. Besides doing this work carefully we go through the regular basic analysis in the absence of phosphates including arsenic, antimony, and tin. We analyze unknown solutions for the different groups and two solutions that cover all the groups, study the tests for more than a dozen common acids and analyze about eight simple solids and mixtures of solids all of which are readily soluble in water or acids.

What kind of a text-book will give the best results?

Saving of time is a very important factor in the success of such a course. It is therefore desirable that the text should contain everything the student needs in just the form in which he is to use it. Additions, modifications, omissions, etc., slow down the course and lessen the interest of the student. The author feels, therefore, that it is well worth while for each teacher to write his own text. We all have our pet ideas about the material which can be most successfully used in such a course. Our text would probably be politely refused by any publisher as "just one more Qualitative Analysis." A clever reviewer could pick it all to pieces. But with our special conditions to meet and our personality behind it, it will be a genuine success. There will be little or no profit from a book privately printed, but at least the cost can be met and the results in efficient teaching will be eminently satisfactory.

How can the teacher keep the student from feeling that there is just one way to do everything in Qualitative Analysis and that as he knows that way he has a complete grasp of the subject?

An excellent remedy is to oblige each student to get at least a little familiarity with some of the standard texts, such as A. A. Noyes, Prescott and Johnson, and Treadwell. One way to accomplish this is to publish a list of "Topics for Study" at the end of each scheme of analysis. It would be simpler for both student and instructor to incorporate in the text a careful discussion of each step in the procedure, but it is certainly broadening to the student if he is given a series of topics to look up and is obliged to get his information by reading the reference to a standard textbook which is given with each topic.

What do the students think of a course of this kind?

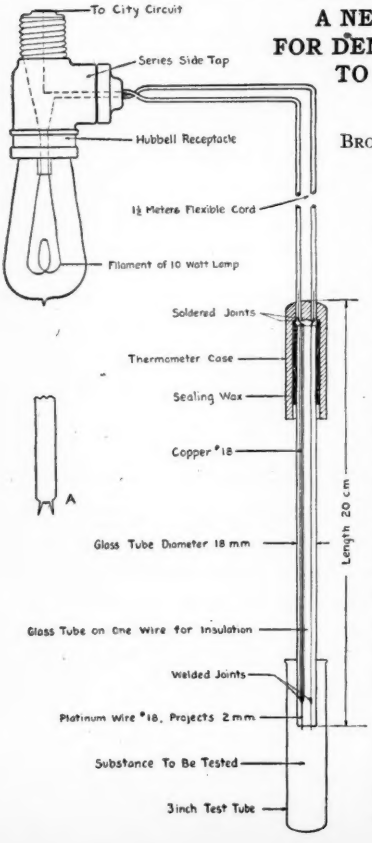
They like it immensely. They feel as if they were really doing something, and can see that their practical knowledge of chemistry is increasing as the term goes on. The poor students are no worse off than they were before. The best students find plenty to keep them busy; and there are always some men who wake up under the stimulus of this kind of work and, instead of just passing, do average or even highly creditable work.

As this discussion has probably indicated, conducting this kind of a course requires more work than a course that attempts to cover nothing but General Chemistry. The results secured, however, more than compensate the instructor for the added effort.

Such an article as this necessarily must be personal and dogmatic. It is hoped that the reader will pardon this and consider the statements made simply as a record of the experience of a single teacher who has taken great satisfaction in following the plan of work indicated.

A NEW LECTURE TABLE OUTFIT FOR DEMONSTRATING CONDUCTIVITY TO ELEMENTARY CLASSES*

HERBERT F. DAVISON,
BROWN UNIVERSITY, PROVIDENCE, R. I.



A glass tube 20 cm. long and 8 mm. in diameter is sealed off at one end. Two horns of glass are drawn out on the sealed end about 4 mm. apart. These are made by heating the glass at the proper point with a very sharp blowpipe flame and sticking into the soft glass a platinum wire, by which it may be drawn out as a small sharp projection tube. The tube should then have the appearance indicated by A. The projections are broken off close to the main tube and holes are thus provided for the platinum wires to project through. These short platinum wires are welded to copper wires which extend the length of the larger glass tube, one being insulated with a small glass tube.

A wooden thermometer case which has been cut down to proper length

* Read before the Section of Chemical Education at the New Haven Meeting of the American Chemical Society, April, 1923.

serves as a cover to keep the apparatus from breaking when out of use, and the cover of this case serves as the handle by which it is manipulated.

An ordinary Hubbell receptacle of porcelain with a series side tap has the side tap connected with the device by about $1^1/_2$ meters of lamp cord.

In use, the solutions whose conductivities are to be tested are put into test-tubes in a rack, and the device dipped into these solutions successively. The lamp glows brightly with good conductors.

The device must be well washed after each use. A stream from a wash bottle is sufficient. The ease of washing and of drying (accomplished with filter paper, or dry cloth) constitute one of the chief advantages of this device over others for the same purpose.

A suggested list of substances to test before the class is here given:

		No glow	Dull glow	Bright
1	Dry salt	X		
2	Distilled water	X		
3	Tap water		X (sometimes)	
4	Salt solution			X
5	Ammonium hydroxide (dil.)		X	
6	Ammonium hydroxide (conc.)	X		
7	Sodium hydroxide			X
8	Glacial acetic acid	X		
9	Dilute glacial acetic acid		X	
10	Hydrochloric acid			X
11	Sulphuric acid (dil.)			X
12	Sulphuric acid (conc.)			X
13	Nitric acid (dil.)			X
14	Glycerine	X		
15	Alcohol	X		
16	Dry sugar	X		
17	Sugar solution	X		
18	Lime water			X

The fact that the apparatus does not have to be taken apart for washing and drying makes it possible to show this whole list in about 15 minutes.

It is astonishing to the students to see that 2 cc. of concentrated hydrochloric acid is enough to render a whole 3 liter battery jar of water a conductor.

If the tap water at the lecture table is non-conducting, a small stream of this may be used to wash the apparatus.

THE KINETIC THEORY—AN EXAMPLE OF RIGHT THINKING

JOHN D. CLARK, UNIVERSITY OF NEW MEXICO, ALBUQUERQUE, N. M.

The usual text-book employed for teaching freshmen chemistry contains an introductory chapter, a chapter on oxygen, and another on hydrogen. The text, having treated these two substances, then takes up the properties of gases in general. That the properties of gases are important cannot be denied. It occupied a prominent place in the student's high school physics text, and it formed a part of his high school course in chemistry. If the

student studied both physics and chemistry in high school, he is apt to slight the college text when he meets the properties of gases for the third time, for the subject matter seems so familiar that he depends upon what he previously learned concerning gases.

The kinetic theory of gases is usually the first theory developed for the freshman. If he has learned his high school physics well, he can perhaps "get by" this chapter with little reference to the text, and as the chapter appears for study at a very busy time in the college career of the newly registered student, at a period when he is not thoroughly adjusted, and when many phases of college life are new and interesting to him, he is likely to regard this chapter as containing something which he has already learned.

The writer regards the teaching of the chapter on the properties of gases as one of the rarest opportunities to drive home, to students (at this time in their lives becoming capable of serious thinking), the difference between fact and the interpretation of fact, the difference between what we know and that which we reason out as a result of what we know. Here the instructor can lay stress upon the urgent necessity for correct observation before arriving at conclusions. Here the instructor has the opportunity to let his class know and realize that he is teaching more than just chemistry, that now the student has the opportunity to learn to think and to reason in the careful, exact manner of the scientist, and although the student may forget most of his chemistry, the formation of the habit of insisting upon the possession of facts before arriving at conclusions, is a thing of lifelong value, a habit possessed altogether too little by people in general.

In teaching this chapter, the writer finds the old story ending with the moral, "Don't jump at conclusions," to be useful. In this story we are told that with the exception of one dog, all the dogs of the village had assembled and were mourning because, as they had been told, the companion now absent from their midst was to be hanged. When gloom is deepest, the absent dog appears wearing a new collar. Then the culprit who had given out the sad report is forced to admit that all he really had known was that he had seen the much discussed dog with his master and that the latter had been adjusting a cord about the dog's neck. Following this, another story illustrates the extreme caution used by some before accepting anything as fact. It is said that "Uncle Joe" Cannon, former speaker of the House of Representatives, was motoring through the country accompanied by some friends. It was springtime and beside the road, in a pasture, huddled a flock of shivering sheep. One of the occupants of the car said to Mr. Cannon, "Those sheep have been shorn," whereupon the former speaker of the House replied, "It appears that way from this side."

Almost without changing a word of the kinetic theory of gases, as given in a much used freshmen text, the writer finds that by rearranging the

clauses and sentences of the text, he can so present the subject that students grasp the significance of correct observation of fact, followed by interpretation or explanation. The matter is presented in two parallel columns thus:

FACTS (*Phenomena which can be demonstrated by experiment.*)	THEORY (*How the mind seeks to explain the facts.*)
"(1) All gases respond in the same way to energy changes such as those of temperature and pressure."	"(1) All gases appear to have the same mechanical structure."
"(2) They are always very compressible and also tend to expand indefinitely."	"(2) They cannot in any sense be continuous matter but must be extremely porous."
"(3) The pressure which gases exert cannot be the thrust of a rigid body, as a spring."	"(3) Under the circumstances almost the only way we can imagine the application of pressure is by the momentum of moving bodies. Hence we can imagine a gas to be made up of moving particles whose aggregate impact is the cause of pressure exerted upon the walls of a containing vessel."
"(4) Boyle's law states that when the volume is reduced one half, the pressure exerted by a gas is doubled."	"(4) This is in accordance with the picture we are drawing, for in half the volume the particles will strike the walls of the vessel twice as often, and will, therefore, exert twice the force on the same area in a given time."
"(5) Since rise in temperature increases pressure." "Kinetic energy of moving particles is equal to the expression $\frac{1}{2}$ ms^2, in which m represents the mass, and s the speed." "Experiment shows that the mass of a gas is not changed by heat."	"(5) Rise in temperature must in some way increase the kinetic energy of moving particles. This might be brought about by increasing the mass or the speed of the particles." "So it must be the speed of the particles which is affected."
"(6) The pressure of all gases increases equally for equal rise in temperature." "Now it can be shown that the masses of two different kinds of gas particles are different."	"(6) So the aggregate energy of the various kinds of gas particles must increase in the same degree." "Therefore the speed of the particles must be increased inversely as the square root of their mass in order that the value of $\frac{1}{2}$ ms^2 may be equally increased for two different particles."

Later on in the course, by way of making clear how often fact and explanation of fact are confused, and how people who apparently are guarded in their statements often state as facts matters which are only surmise, the writer has found the following useful: When the freshman class assembles, each student finds on the arm of his chair, a slip of paper. The instructor says nothing to the class, but stooping behind the lecture table, fires a .22 caliber blank cartridge. He then uncovers the blackboard and there the students sees these directions, "Being very careful to write only what you know to be a facts, tell what has happened." After all the students have written, they are then given these additional directions: "On the other side of your paper write what you consider an explanation of the facts." Following the hour, the answers are classified and copied and a long list of correct and incorrect answers is posted. Groups of students gathered around the posted answers, seeming to get much satisfaction from bantering each other about the statements which they have made. It is surprising indeed to note how many students, even now, jump at conclusions and give their conclusions as fact. A large percentage of the students, when writing what they know to be a fact, say that a mixture of hydrogen and oxygen has been exploded. This might be very satisfactory as an explanation (although not correct), but, of course, it is more than the student knows as fact.

As the time arrives for the development of the theory of ionization, the average student, having had the setting which is given in the preceding paragraphs, finds it easy to take the words of the text and select those sentences which are statements of observations of experiment and place them in one column, and to place in a parallel column the picture or theory which we reason out as a result of trying to explain the facts, and he finds it easy to remember his facts and explanations. This average student has made a long advance in correct thinking and reasoning while he has been studying chemistry.

ABSTRACTS FOR THE WASHINGTON MEETING

The abstracts of the papers here listed have been presented for reading before the Section of Chemical Education at the Washington Meeting, April 21st to 26th. These abstracts were received too late to be placed in the March issue of THIS JOURNAL.

Laboratory Practice in Atomic Structure. WILLIAM LLOYD EVANS AND JESSE E. DAY. This paper deals with an account of some experiments carried on with a class of six hundred students in making atomic models of the Lewis-Langmuir type. The work was organized for the purpose of showing that this type of atomic structure harmonized with the periodic

law, with our valence conceptions, and with the theory of electrolytic dissociation. The idea of isosteric elements and compounds was also developed by the use of these models.

In and Out of the Class-Room with Doctor Edward Williams Morley. C. C. KIPLINGER. A brief description of Doctor Morley's teaching methods and personality in the class-room. Also a few episodes in which Doctor Morley figured.

A Plea for Rationally Coördinated Courses in Analytical Chemistry. PAUL H. M. P. BRINTON. Failure to closely coördinate the work in qualitative and quantitative analysis leads to much confusion in students' grasp of the principles of analytical chemistry. It is suggested that a unified system of instruction be adopted, in the first course of which (qualitative analysis) the fundamental principles of analytical chemistry should be presented not as a finished structure, completely supported by rigorous mathematical treatment, but as a fairly simple, yet firm, foundation upon which the more complete structure could be developed in the following courses in quantitative analysis. The courses in quantitative analysis should furnish a development, not a mere re-statement, of the principles presented in the qualitative course.

Should Teachers do Research or Commercial Work? C. C. HEDGES. Teachers, research men, and executives should be selected for the respective places according to ability shown for each kind of work. A teacher is not necessarily a good research man as the mind required for each is not the same. Teachers should devote their entire time to teaching and not do research or commercial work but use their spare time in studying the latest developments in their field. Graduate students should be instructed by special research men and the problem should be outlined. Graduate students should not be used on commercial work unless a comprehensive view of the details is given.

The Place of the Metals in the Introductory Course. R. A. BAKER. Without seriously disturbing the conventional order followed in most texts, it has been found that the metals as a group can be introduced to great advantage very early in the Course.

Students without previous chemical training are benefited by this practice as much as, it not more than, those who enter with high school credit in chemistry. It is believed that the value of this arrangement can be demonstrated with any beginning class.

A "Painless" Method for Preparation of Chlorine. JACOB CORNOG. All persons who have been present in laboratories when the preparation of chlorine was part of the exercise are familiar with the discomforts arising from the chlorine which escapes into the air of the room. With large sections and poor ventilation the condition becomes acute. During the past two years we have greatly minimized the quantity of chlorine es-

caping into the laboratory by the simple expedient of collecting it over water in a pneumatic trough exactly as oxygen and hydrogen are usually collected. Under the circumstances the rate of solution of chlorine in water is so slow that it does not interfere. If in addition to the foregoing chlorine coming from the generator is passed into a thiosulfate solution when not being collected the laboratory becomes quite habitable.

The only caution to be mentioned arises when the addition of metallic sodium to free chlorine is part of the exercise. The action between sodium and water is to be remembered.

Chemical Engineering Education. J. H. JAMES. Chemical engineering a logical development from other engineering and chemistry, just as civil engineering was an outgrowth of military engineering. Criticisms of chemical engineering education reviewed and answered. Evolution of this branch of education in American institutions. An attempt to give a good distribution of the various subjects as to time, in a four-year course. Arguments for a longer course.

The Difference between the Half Sum and the Square Root of the Product when Weighing by the Method of Gauss. S. F. HOWARD AND T. A. MARTIN. If the weights are "*a*" and "*b*," the true weight is *ab*. When *a* does not equal *b* the half sum is not the true weight but is close to it.

Given *a* semicircle whose diameter is *a* plus *b*. The radius is the half sum while the perpendicular from the meeting point of *a* and *b* is *ab*. The difference between the radius and the perpendicular is the error in using the half sum to calculate the true weight.

A formula is derived for calculating the error for different values of *a* and *b*. When *a* and *b* vary by .25% the error is only .00008%. For 1% the error is .00125%. For 2% the error is .005%.

Problems Associated with the Construction of a High School Chemistry Course. EARL R. GLENN. This paper discusses the following points relating to the teaching of Chemistry in American high schools:

a. The coördination of Chemistry and other science subjects.
b. Enrollment in Chemistry in large cities and in typical states.
c. How generally is Chemistry taught in the small high school?
d. What is the training of the Chemistry teacher now in service and what should be the training of the prospective teacher?
e. What constitutes adequate laboratory equipment for the various types of high schools?
f. What has been the influence of the College Entrance Examination Board on high school Chemistry in America and what is the probable influence of this Board in the future?
g. How is the teaching of Chemistry influenced by program-making on the part of the high school principal by the State Board of Education?
h. Have we arrived at perfection in text-book construction?
i. Shall we depend upon committee judgment unsupported by adequate evidence or shall we study the various problems scientifically and plan the high school course accordingly?

Some Chemical Training that is Hard to Find. H. A. WEBB.

A New System for Evaluating Student Work. ALEXANDER SILVERMAN.

Brands from the Burning. ELLIOT Q. ADAMS. A discussion of Prof. A. P. Sy's "Plea for a Pedagogical Scrapheap in Chemistry" and a defense of some of the terms there criticised.

A System of Conducting a Laboratory Course in Elementary Quantitative Analysis. GEORGE D. BEAL AND S. A. BRALEY.
A Promising Field of Chemical Education. HARRISON HALE.
The Need for a Course about Chemistry. CHAS. W. CUNO.
Report of Committee on Chemical Education. N. E. GORDON, *Chairman.*

COLLEGE RESEARCH

HARRY N. HOLMES, OBERLIN COLLEGE, OBERLIN, O.

In the January number of THIS JOURNAL, Dr. Patrick admonishes the college professor to leave research alone.

I fear that this is a dangerous doctrine. Had Morley heeded such advice during his professorship in Adelbert College of Western Reserve University he would not have given to science his great classic on the combining weights of oxygen and hydrogen. In the same city Professor Dayton Miller is now teaching physics. Case is a technical school with no great stress put on graduate work, yet Professor Miller manages to do most excellent undergraduate teaching while earning a reputation as one of our greatest authorities on sound.

In the early years at Johns Hopkins, Professor Remsen himself lectured to the undergraduates, yet he did not feel that this weakened the quality of his research work. I have heard him lament the fact that so many men trained to research fell into a rut in college teaching and dropped research completely.

Last April at a meeting of the Division of Chemistry of the National Research Council it was voted to encourage the college teacher to engage in research. None present approved this action more vigorously than did Dr. A. A. Noyes.

All research men do not flash into bri liance suddenly like meteors; some have to develop the higher candle power slowly. This does not mean, however, that they may not finally become stars of appreciable magnitude.

A stimulating freshness and a feeling of authority come to the college teacher as he unravels the secrets of science. The teacher profits, the great body of science profits, and the pupil profits. The pupil then feels that he is near one of the fresh springs that feed the stream of knowledge into which he has been dipping.

OBERLIN COLLEGE

Local Activities and Opportunities

J. H. Reedy: Assistant Professor of the Inorganic Division, of the Chemistry Department, University of Illinois, spoke before the Illinois-Iowa Section of the American Chemical Society, March 3, 1924. The subject of his address was: "The Corrosion of Metals."

R. V. Wheeler: Professor Fuel Technology, Sheffield University, England, was entertained at luncheon at the Urbana-Lincoln Hotel by the Chemistry Department and the heads of the Engineering Experimental Stations, Geological Survey and Bureau of Mines. Professor Wheeler addressed the Illinois Section of the American Chemical Society, Wednesday evening March 12th on the work of the Coal Research Laboratory of the University of Sheffield. His research was particularly interesting to the members of the University of Illinois, as it parallels that of Professor S. W. Parr.

University of Florida: The Departments of Chemistry and Pharmacy of the University of Florida are coöperating with the General Extension Division of the University in the publication of several bulletins which will be distributed throughout the state. The titles of those which have been completed or are in preparation are: "Chemistry in the Household," "Helps for Amateur Photographers," "Medicines in the Home" and "An Ounce of Prevention---."

Townes R. Leigh: Head of the Department of Chemistry of Florida, was elected as first chairman of the newly formed section of the American Chemical Society, and Dr. F. H. Health, also of the Department of Chemistry, was elected Secretary.

University of Nebraska: The Nebraska State Teachers' Science Section held their meeting at Nebraska University on March 14th. Professor A. A. Durham, Nebraska Wesleyan University presided. The following program was given.

Topic: What shall we teach as high school chemistry?

I. As a college teacher sees it. Dr. C. S. Hamilton, University of Nebraska.

II. A High School Teacher's Judgment. A. C. Lendthe, Columbus High School.

III. Speaking for the executive and the teacher of an applied subject. Supt. R. B. Bedell, Ashland Public Schools.

Each paper was followed by a lively discussion which resulted in a large benefit to all present.

University of Pittsburgh: Alexander Silverman, Head, Department of Chemistry, University of Pittsburgh, gave a very interesting lecture before the Academy of Science and Art of Pittsburgh, Thursday, March 6th at 8:15 P.M. about The Silk-Worm's Competitors, illustrating it with lantern slides, a large exhibit of eggs, worms, cocoons, and natural and artificial silk.

Chemist with Ph.D. degree from a leading Eastern University, thoroughly trained and well qualified, ten years' experience in teaching inorganic and organic chemistry, desirous of obtaining a position where he can carry on some research with teaching. Thirty-four years old. Address Box ——, Care J. Chem. Educ., Easton, Pennsylvania.

Carnegie Institute of Technology: The Coöperative Mining Courses of the Carnegie Institute of Technology offer six fellowships in coal mining research, in coöperation with the Pittsburgh Experiment Station of the United States Bureau of Mines and an Advisory Board of Mine Operators and Engineers. Fellowships are open to the graduates of colleges, universities and technical schools who are properly qualified to undertake research investigations. The value of each fellowship is $750 per year of ten months. Address all communications to Supervisor, Coöperative Mining Courses, Carnegie Institute of Technology, Pittsburgh, Pennsylvania.

Professor Lyman C. Newell, head of the Department of Chemistry in Boston University, delivered an address on "The Earlier and Later Days of Chemistry in New England" at the twenty-fifth anniversary meeting of the New England Association of Chemistry Teachers, held March 15 in Malden, Mass., where the organization was founded. The address was illustrated with lantern slides, portraits, and autograph letters from Dr. Newell's collection. In recognition of his services to the Association Dr. Newell was presented with a copy of resolutions adopted at this meeting. The resolutions acknowledge the work which Dr. Newell has done for the society and express the thanks of the organization for his unbroken services in many ways. Dr. Newell was a moving spirit in the formation of the Association. He was its first president and now holds the office of Curator of the library and museum.

TESTIMONIAL DINNER

IN HONOR OF

HON. FRANCIS P. GARVIN

Saturday Evening, - - April 26, 1924

THE WALDORF-ASTORIA

EIGHT-THIRTY O'CLOCK

This event is being arranged by the Presidents of the following National Organizations of Chemistry:

AMERICAN CHEMICAL SOCIETY
Dr. Leo H. Baekeland, *President*

AMERICAN ELECTROCHEMICAL SOCIETY
Mr. Arthur T. Hinckley, *President*

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS
Dr. Charles L. Reese, *President*

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS
Dr. Louis A. Olney, *President*

MANUFACTURING CHEMISTS' ASSOCIATION
Mr. Elon H. Hooker, *President*

SALESMEN'S ASSOCIATION OF THE CHEMICAL INDUSTRY
Mr. Ralph E. Dorland, *President*

SYNTHETIC ORGANIC CHEMICAL MANUFACTURERS ASSOCIATION
Dr. Chas. H. Herty, *President*

Participants may subscribe for individual covers, or may reserve tables arranged for ten persons. Check covering subscription price of Six Dollars per cover should accompany all reservations. Please list names of guests on the enclosed subscription card (write legibly). Subscribers desiring to sit with other guests, though not reserving a complete table, should indicate their wishes.

Names for the seating list must be received not later than Friday, April 25th.

Ladies Invited *Formal*

Make checks payable to A. V. H. Mory, *Treasurer*, and mail to One Madison Avenue, Room 343, New York City.

CHAS. H. HERTY, *Chairman*

BOOK REVIEW

Organic Chemistry for Advanced Students, Fourth Edition. By JULIUS B. COHEN, Ph.D., B.S., F.R.S., Professor of Organic Chemistry in the University of Leeds. Longmans, Green and Co., New York City. Three parts, each part $6.00.

Cohen's "Organic Chemistry for Advanced Students" has been so long and favorably known as to make any criticism seem like sacrilege, and indeed, the new edition deserves very little but favorable comment. The work has been brought well up to the date of printing, including discussions of the most important papers in the field of organic chemistry which appeared during the early part of 1923.

The discussion of the older work remains almost unchanged, word for word, from the last edition, and that of the more recent advances has been inserted largely in the form of additional paragraphs. The insertion has been so well done that the readability of the book is unimpaired. The only disadvantage is that the spacing of the type has been widened or compressed in places in a manner that is sometimes almost painfully obvious, in order that whole page settings of the last edition may be used.

On the whole, the work may be recommended without hesitation for the use of the advanced student and for the organic chemist who wishes a good general resumé of fields other than his own. It well deserves a place in any chemist's library.

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